



US009078312B2

(12) **United States Patent**
Dai et al.

(10) **Patent No.:** **US 9,078,312 B2**
(45) **Date of Patent:** **Jul. 7, 2015**

(54) **MULTICHIP PACKAGE STRUCTURE FOR DIRECTLY ELECTRICALLY CONNECTING TO AN AC POWER SOURCE**

USPC 315/294
See application file for complete search history.

(75) Inventors: **Shih-Neng Dai**, Zhongli (TW);
Chia-Tin Chung, Toufen Township,
Miaoli County (TW)

(73) Assignee: **PARAGON SEMICONDUCTOR LIGHTING TECHNOLOGY CO., LTD.**, Taoyuan County (TW)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2008/0220549	A1 *	9/2008	Nall et al.	438/26
2009/0206350	A1 *	8/2009	Wang et al.	257/88
2010/0109558	A1 *	5/2010	Chew	315/294
2011/0050071	A1 *	3/2011	Chung et al.	313/46

FOREIGN PATENT DOCUMENTS

CN 200810039728 * 12/2009

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1204 days.

(21) Appl. No.: **12/964,415**

(22) Filed: **Dec. 9, 2010**

(65) **Prior Publication Data**

US 2012/0098458 A1 Apr. 26, 2012

(30) **Foreign Application Priority Data**

Oct. 22, 2010 (TW) 99136119 A

(51) **Int. Cl.**

H05B 33/08 (2006.01)

F21K 99/00 (2010.01)

H01L 25/16 (2006.01)

H01L 25/075 (2006.01)

(52) **U.S. Cl.**

CPC **H05B 33/0812** (2013.01); **F21K 9/00** (2013.01); **H01L 25/0753** (2013.01); **H01L 25/167** (2013.01); **H05B 33/0821** (2013.01); **Y02B 20/348** (2013.01); **H01L 2224/48091** (2013.01); **H01L 2924/3025** (2013.01)

(58) **Field of Classification Search**

CPC H05B 37/02

Primary Examiner — Alexander H Taningco

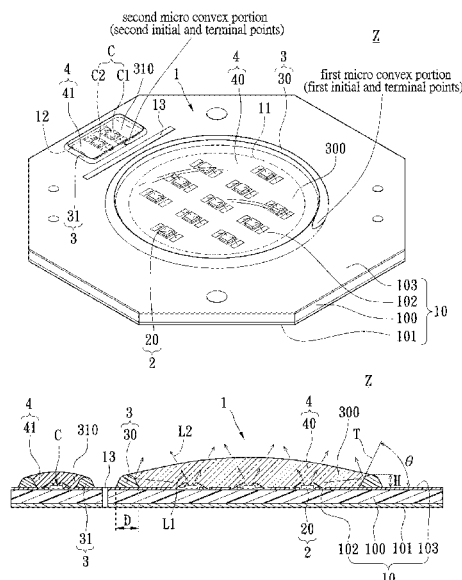
Assistant Examiner — David Lotter

(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, P.C.

(57) **ABSTRACT**

A multichip package structure includes a substrate unit, a light-emitting unit, a control module, a frame unit and a package unit. The substrate unit includes a first chip-placing region and a second chip-placing region. The light-emitting unit includes a plurality of light-emitting chips electrically connected to the first chip-placing region. The control module includes at least one current-limiting unit and the rectifier unit electrically connected to the second chip-placing region and the light-emitting unit. The frame unit includes a first annular colloid frame surrounding the light-emitting chips and a second annular colloid frame surrounding the current-limiting unit and the rectifier unit. The package unit includes a first package colloid body surrounded by the first annular colloid frame to cover the light-emitting chips and a second package colloid body surrounded by the second annular colloid frame to cover the current-limiting unit and the rectifier unit.

13 Claims, 14 Drawing Sheets



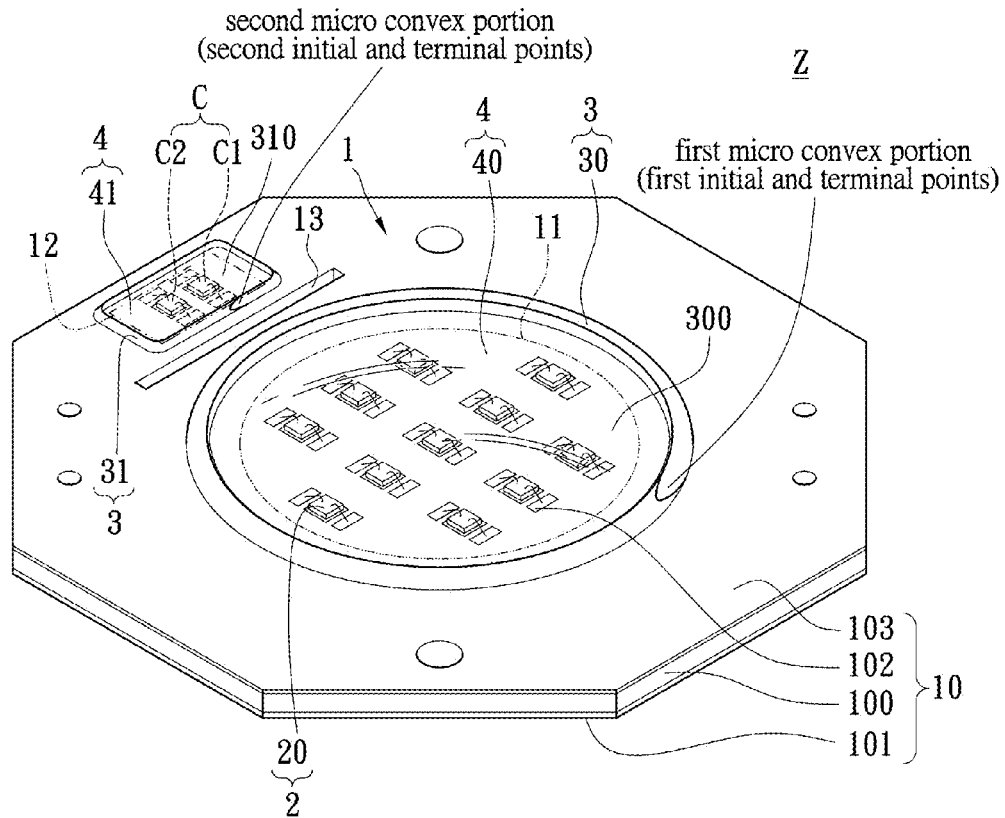


FIG. 1A

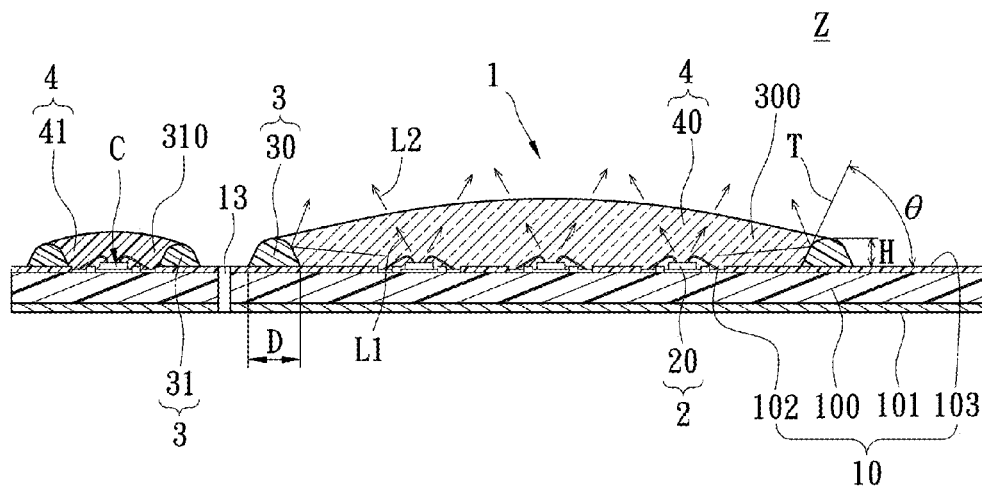


FIG. 1B

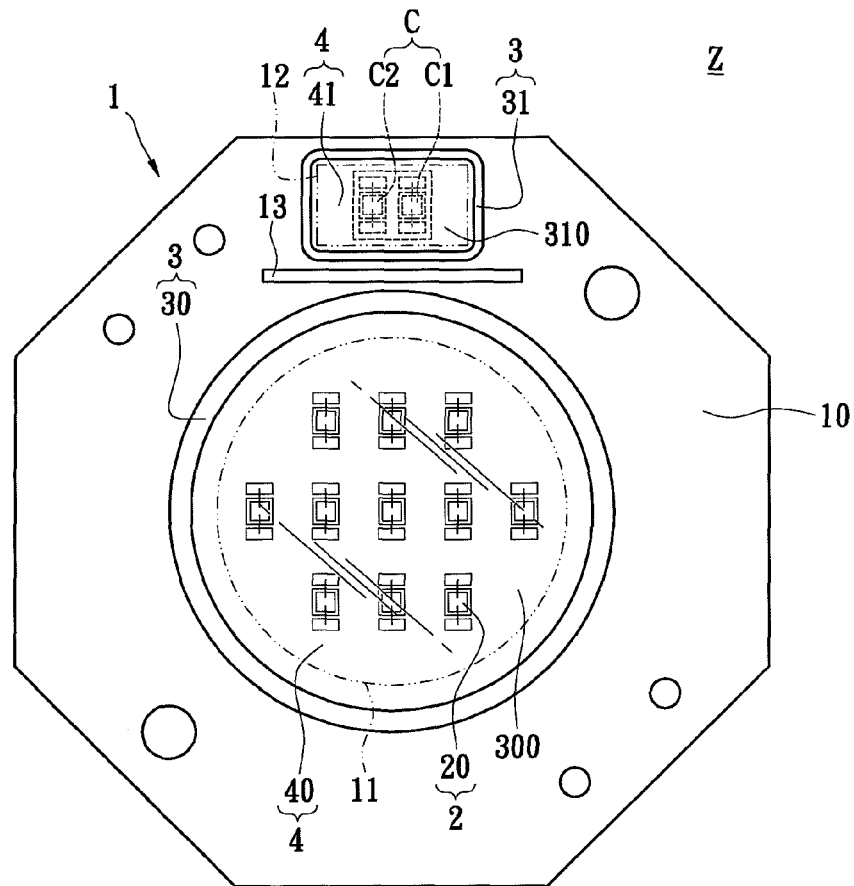


FIG. 1C

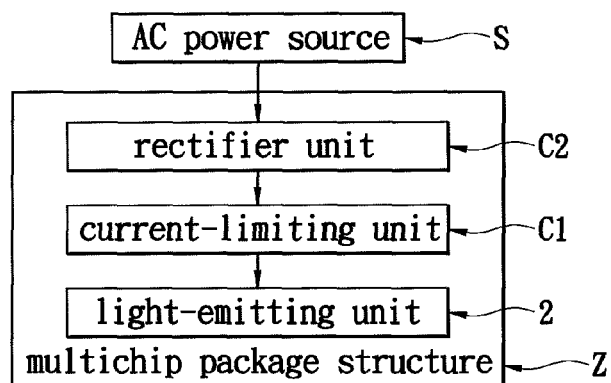


FIG. 1D

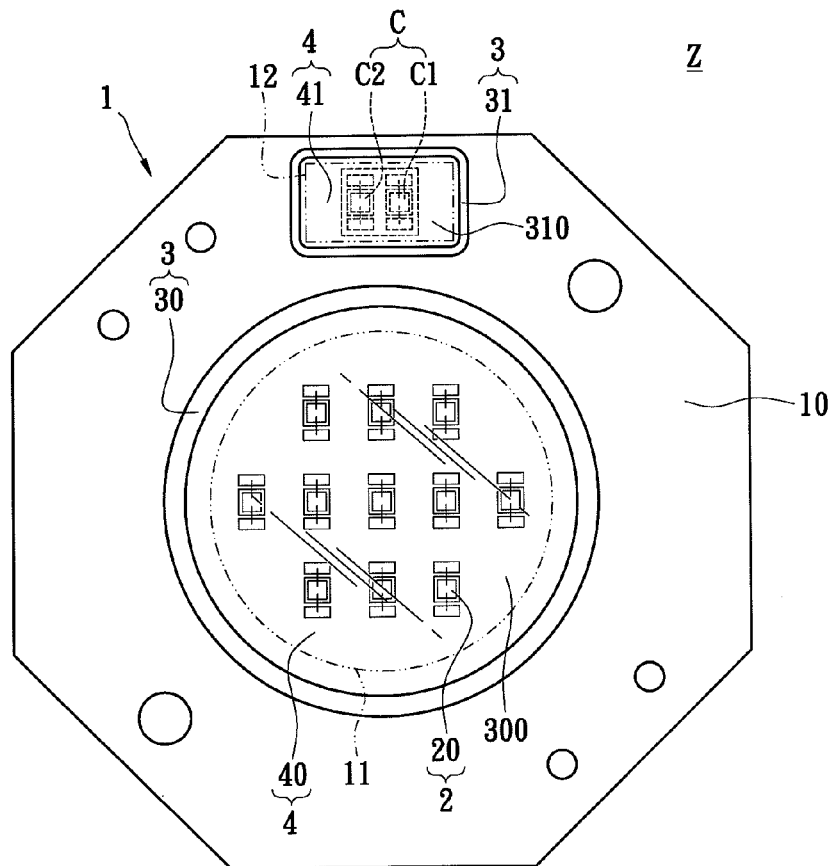


FIG. 2A

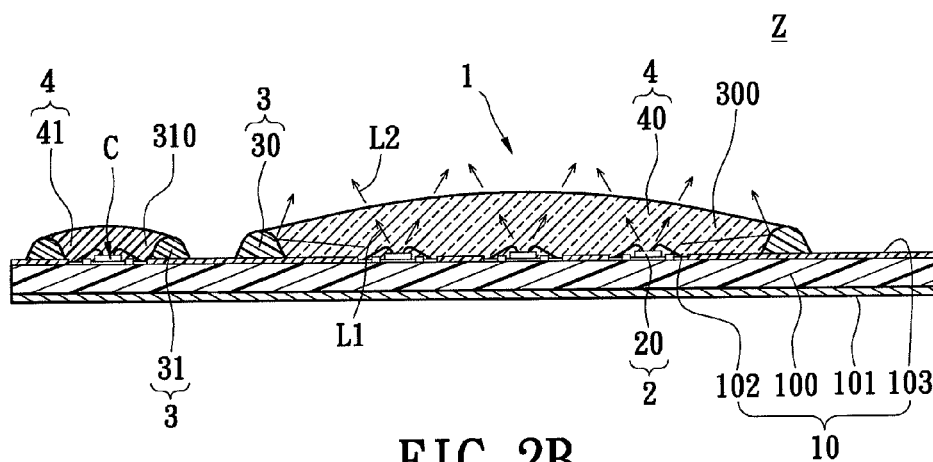


FIG. 2B

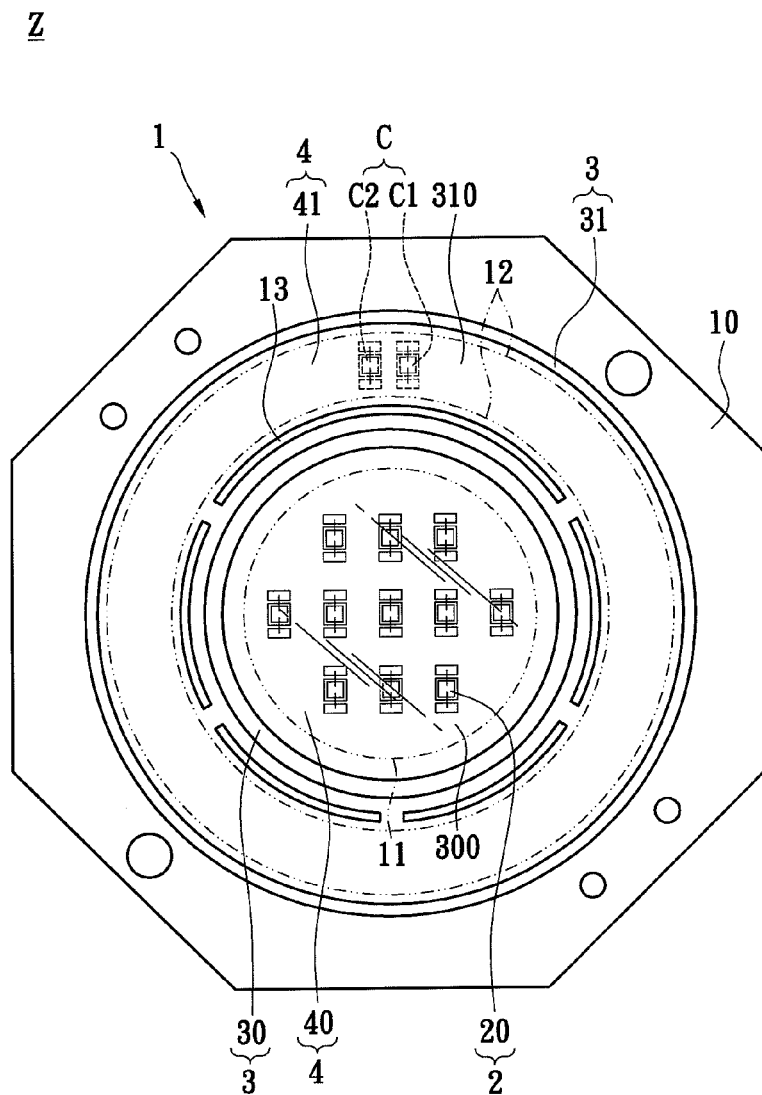


FIG. 3

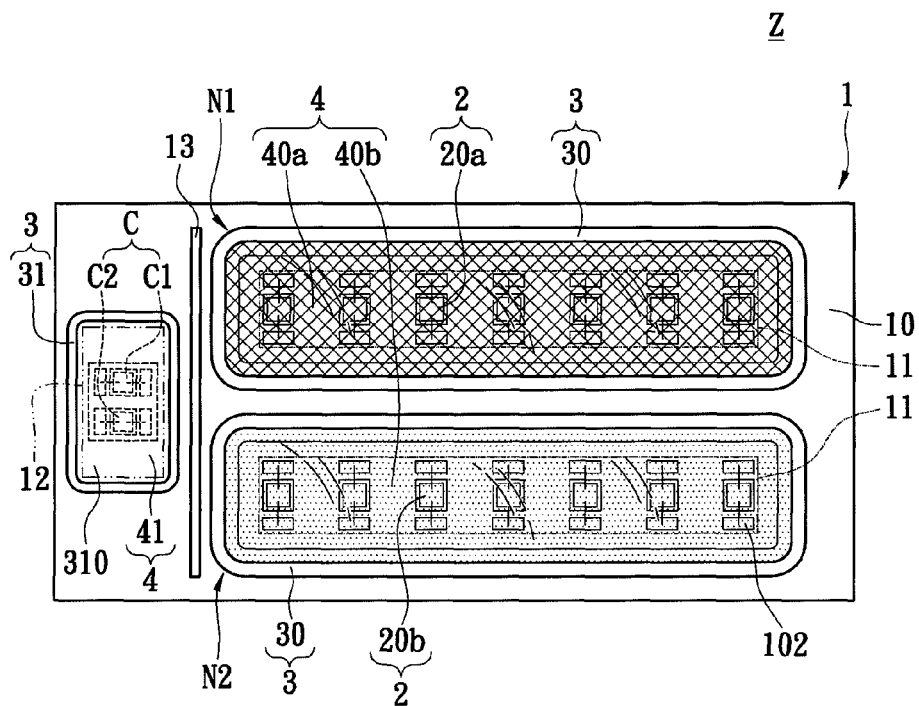


FIG. 4A

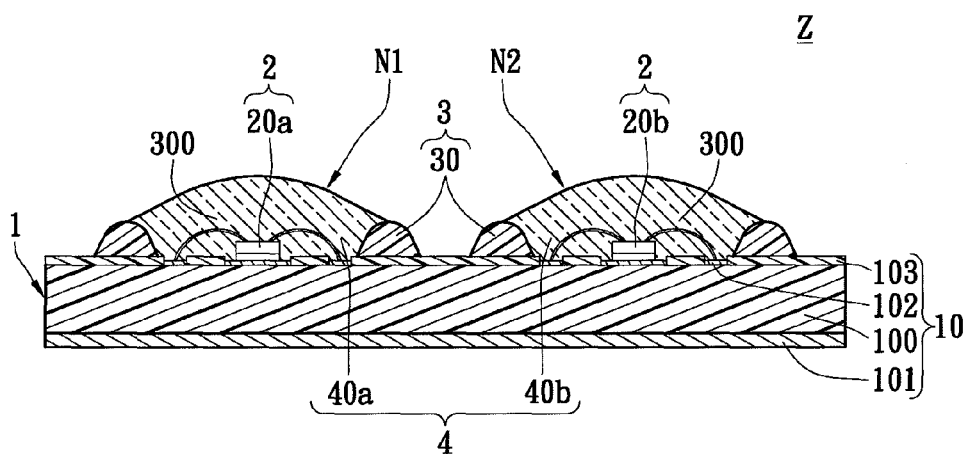


FIG. 4B

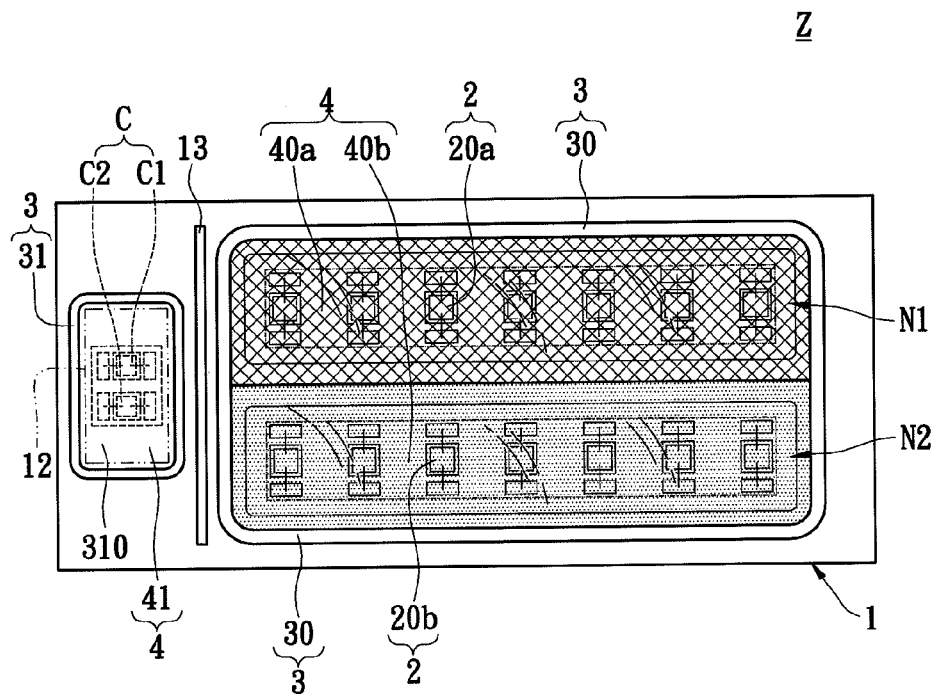


FIG. 5A

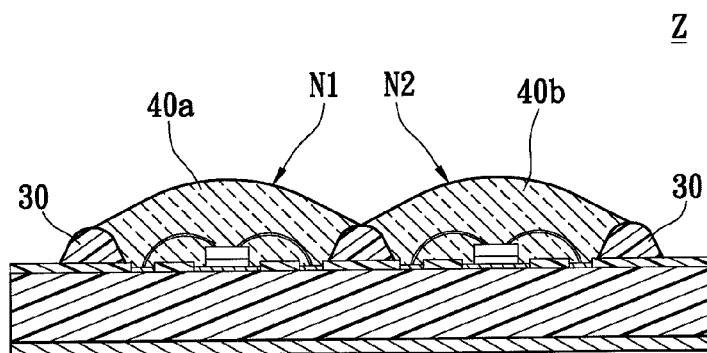


FIG. 5B

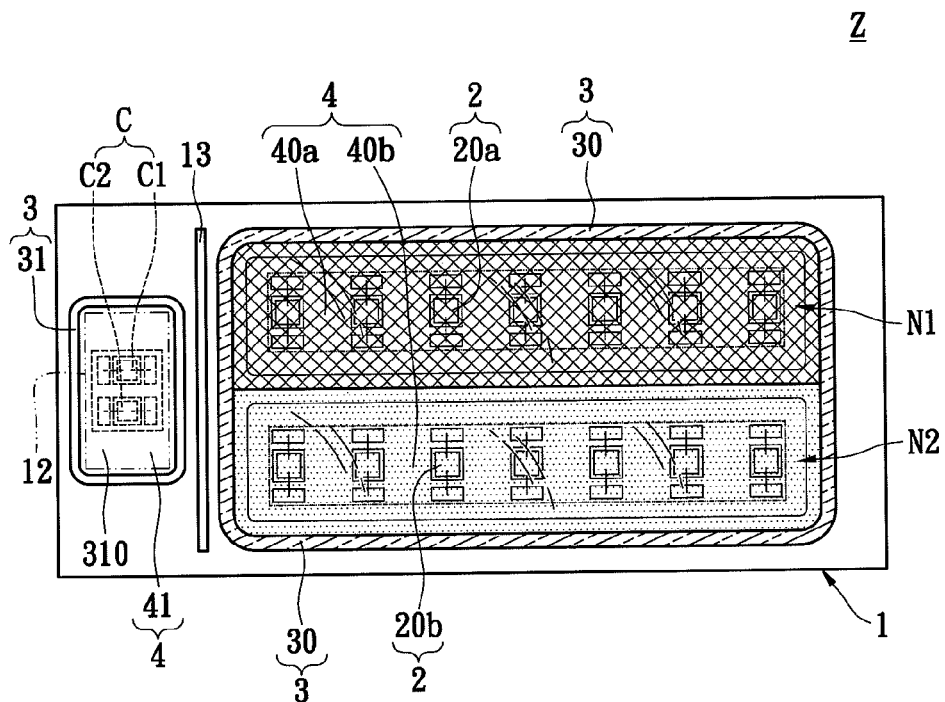


FIG. 6A

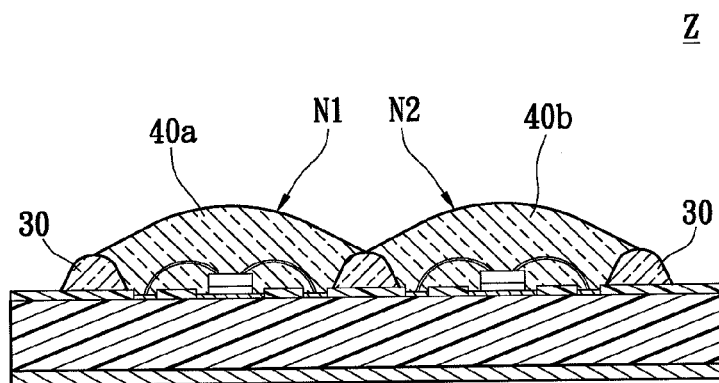


FIG. 6B

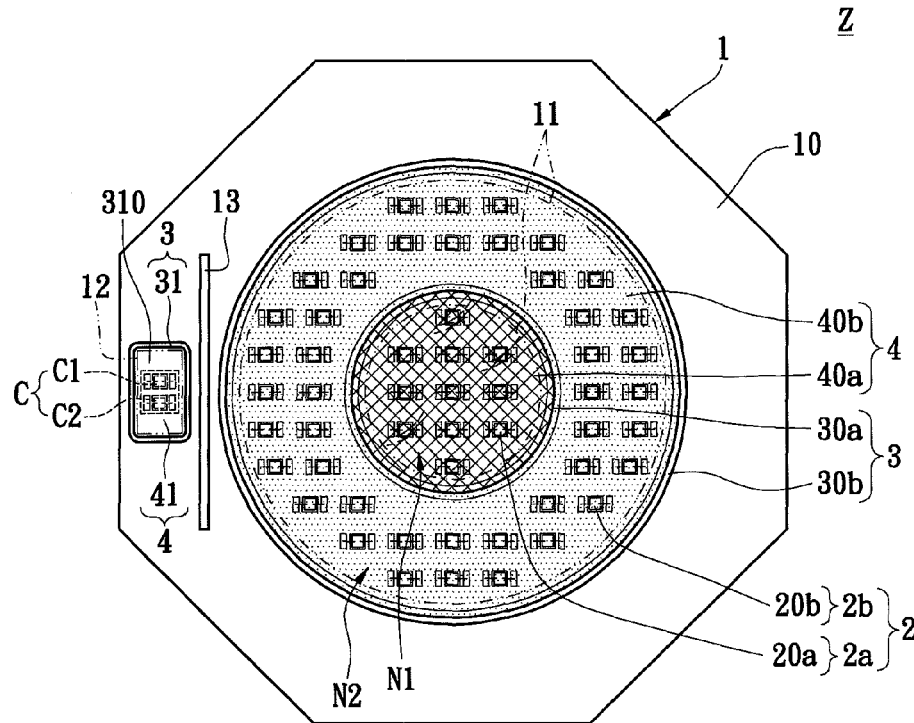


FIG. 7A

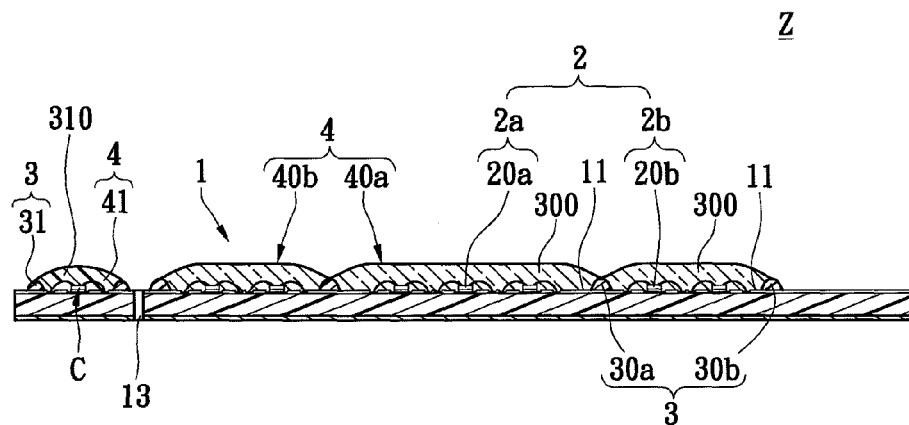


FIG. 7B

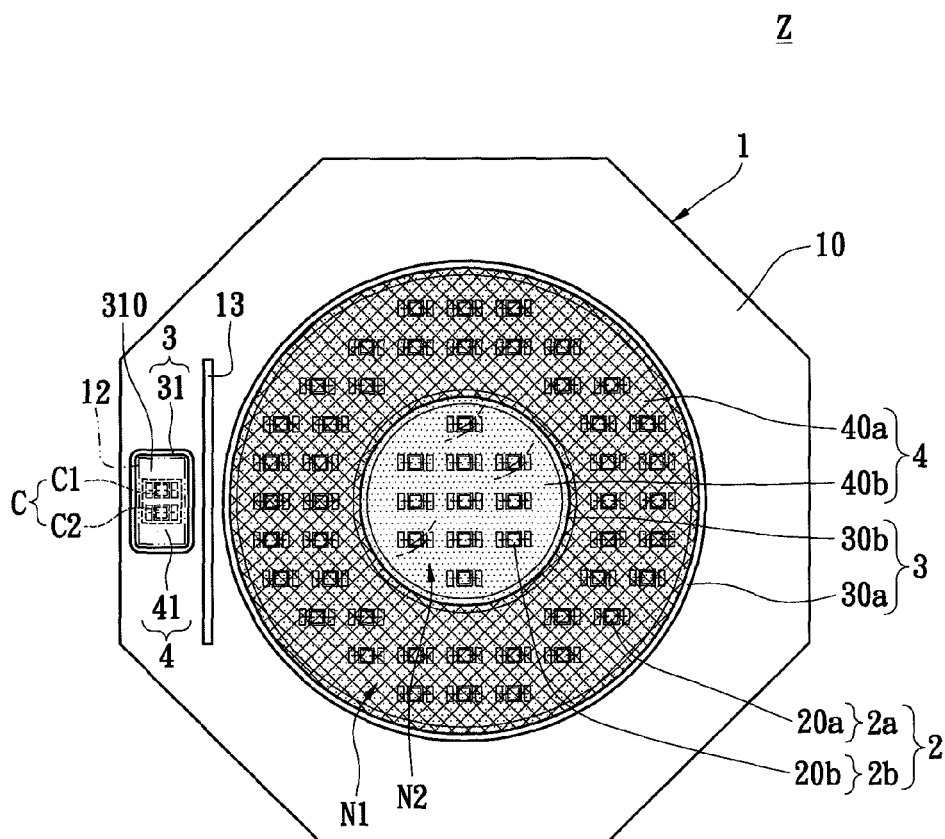


FIG. 8

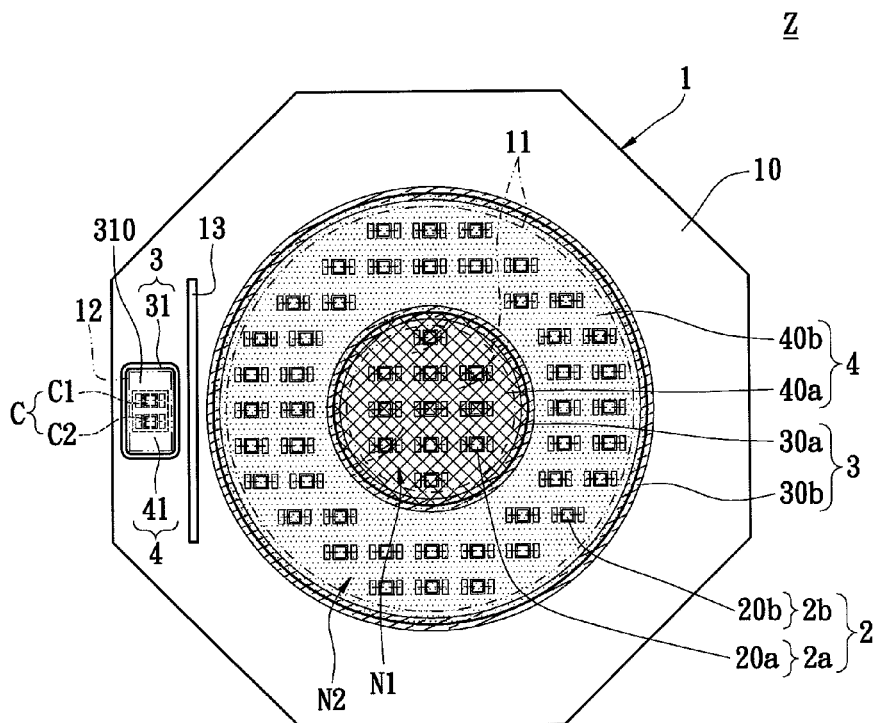


FIG. 9A

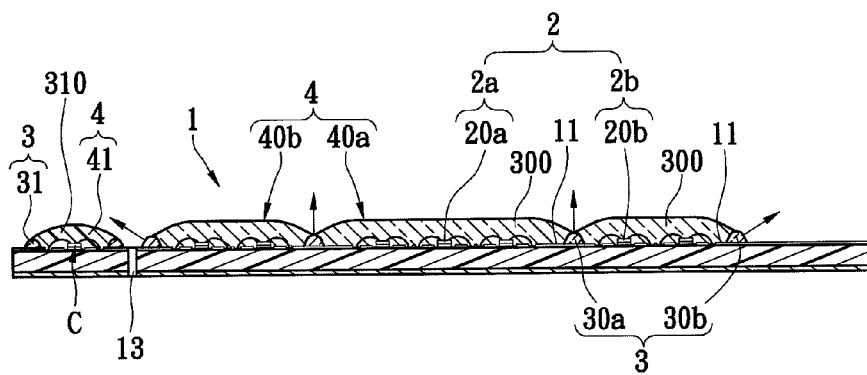


FIG. 9B

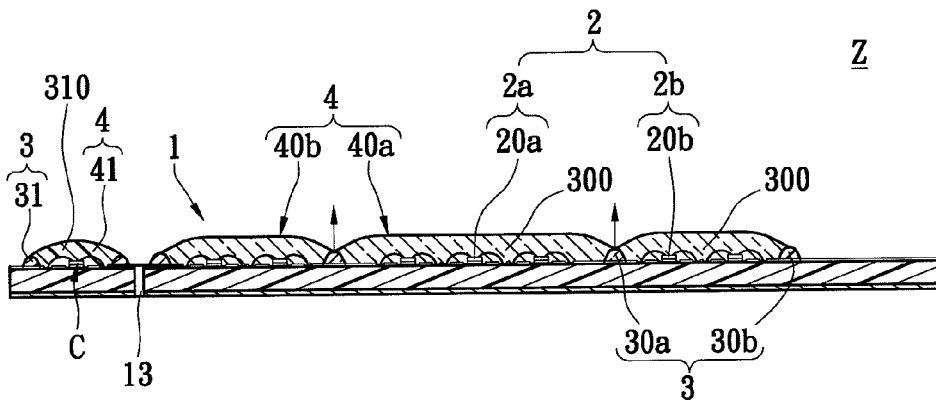


FIG. 10

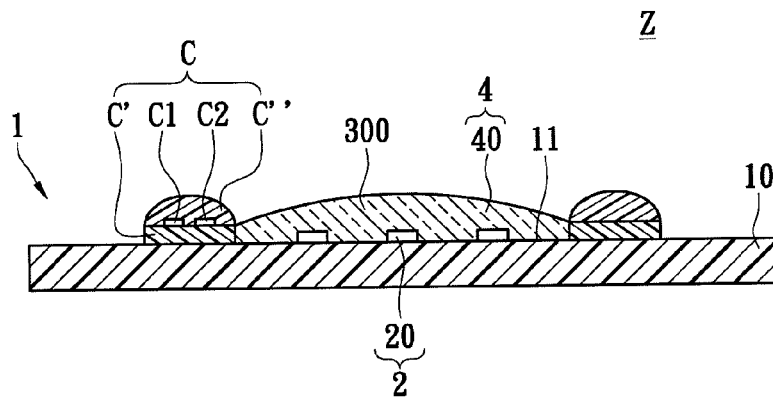


FIG. 11

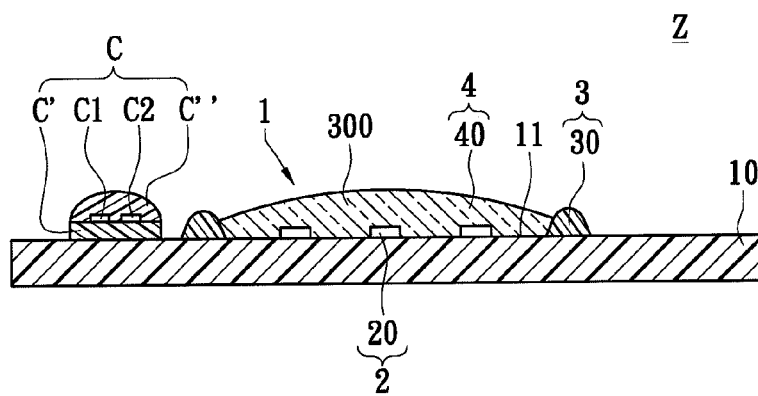


FIG. 12

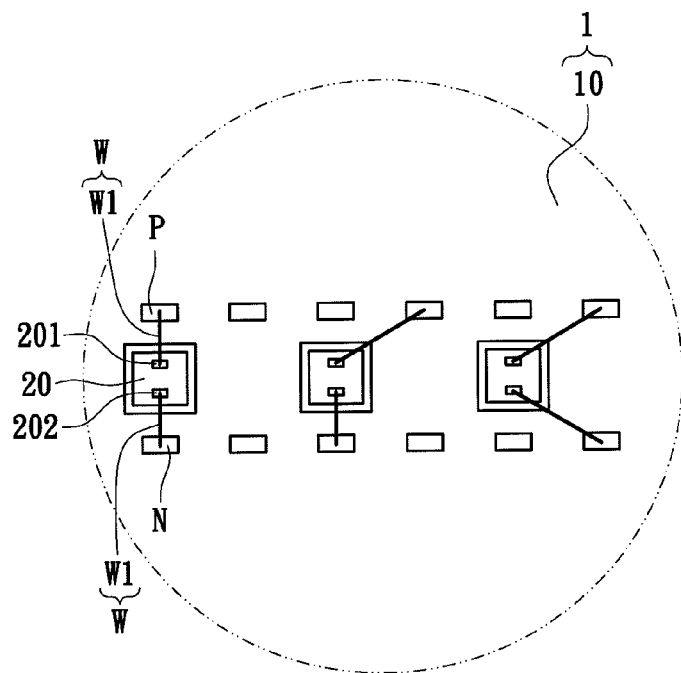


FIG. 13

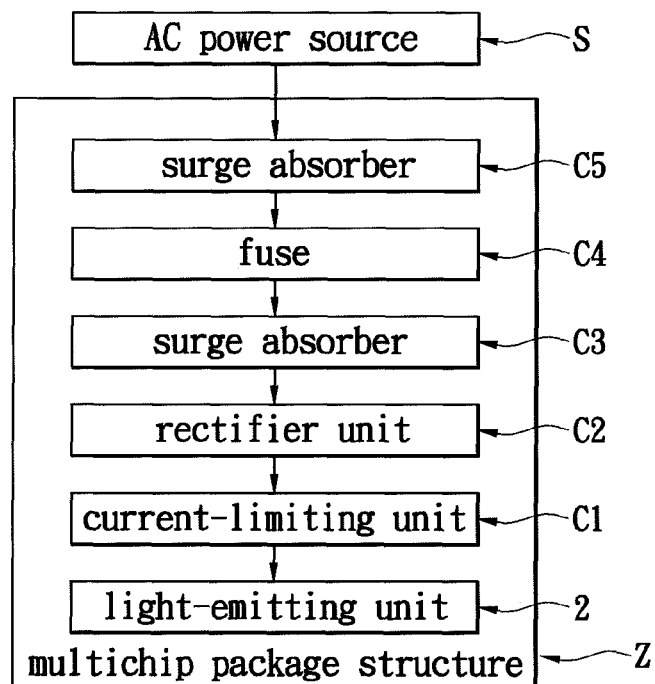


FIG. 14A

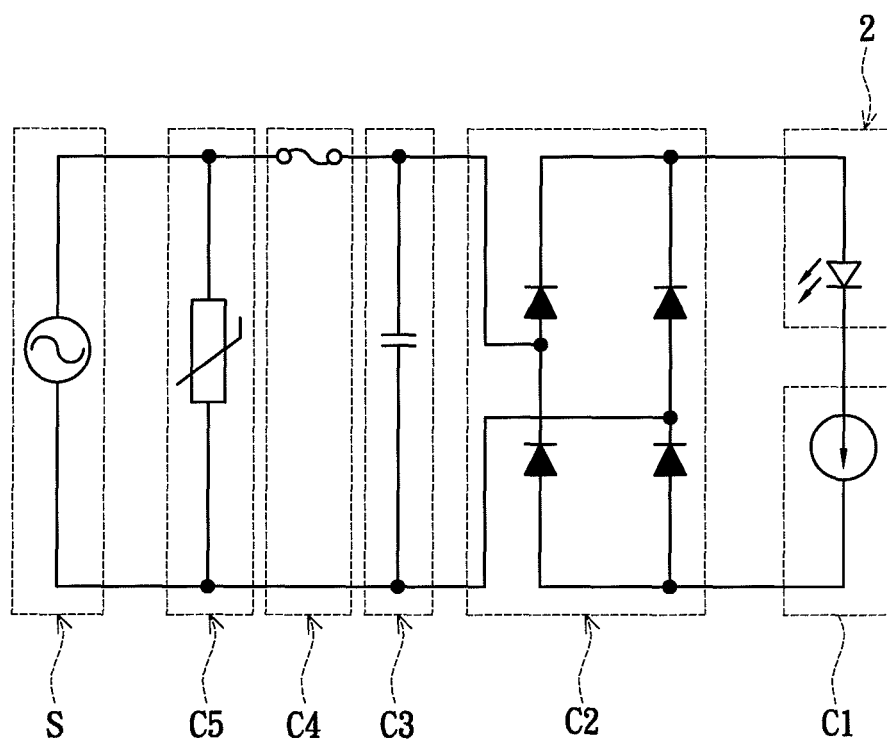


FIG. 14B

1

MULTICHIP PACKAGE STRUCTURE FOR DIRECTLY ELECTRICALLY CONNECTING TO AN AC POWER SOURCE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The instant disclosure relates to a multichip package structure, and more particularly, to a multichip package structure for directly electrically connecting to an AC (Alternating Current) power source.

2. Description of Related Art

The invention of the lamp greatly changed the style of building construction and the living style of human beings, allowing people to work during the night. Traditional lighting devices such as lamps that adopt incandescent bulbs, fluorescent bulbs, or power-saving bulbs have been generally well-developed and used intensively indoor illumination. However, compared to the newly developed light-emitting-diode (LED) lamps, these traditional lamps have the disadvantages of quick attenuation, high power consumption, high heat generation, short working life, high fragility, and being not recyclable. Thus, various LED package structures are created to replace the traditional lighting devices.

SUMMARY OF THE INVENTION

One particular aspect of the instant disclosure is to provide a multichip package structure that can directly electrically connect to an AC power source (such as commercial AC power socket) as power supply source.

To achieve the above-mentioned advantages, one embodiment of the instant disclosure provides a multichip package structure, comprising: a substrate unit, a light-emitting unit, a control module, a frame unit and a package unit. The substrate unit includes a substrate body having a first chip-placing region and a second chip-placing region formed on the top surface of the substrate body. The light-emitting unit includes a plurality of light-emitting chips electrically connected to and disposed on the first chip-placing region. The control module includes at least one current-limiting unit and at least one rectifier unit electrically connected to and disposed on the second chip-placing region, and the current-limiting unit and the rectifier unit are electrically connected to the light-emitting unit. The frame unit includes a first annular colloid frame and a second annular colloid frame surrounding formed on the top surface of the substrate body. The first annular colloid frame surrounds the light-emitting chips to form a first colloid position limiting space corresponding to the first chip-placing region, and the second annular colloid frame surrounds the current-limiting unit and the rectifier unit to form a second colloid position limiting space corresponding to the second chip-placing region. The package unit includes a first package colloid body filled into the first colloid position limiting space to cover the light-emitting chips and a second package colloid body filled into the second colloid position limiting space to cover the current-limiting unit and the rectifier unit.

Therefore, the light-emitting chips, the at least one current-limiting unit and the at least one rectifier unit are electrically connected to the same substrate body, thus the multichip package structure can directly electrically connect to an AC power source (such as commercial AC power socket) as power supply source.

To further understand the techniques, means and effects the instant disclosure takes for achieving the prescribed objectives, the following detailed descriptions and appended drawings are hereby referred, such that, through which, the pur-

2

poses, features and aspects of the instant disclosure can be thoroughly and concretely appreciated. However, the appended drawings are provided solely for reference and illustration, without any intention that they be used for limiting the instant disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A shows a perspective, schematic view of the multichip package structure according to the first embodiment of the instant disclosure;

FIG. 1B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the first embodiment of the instant disclosure;

FIG. 1C shows a top, schematic view of the multichip package structure according to the first embodiment of the instant disclosure;

FIG. 1D shows a function block diagram of the multichip package structure according to the first embodiment of the instant disclosure;

FIG. 2A shows a top, schematic view of the multichip package structure according to the second embodiment of the instant disclosure;

FIG. 2B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the second embodiment of the instant disclosure;

FIG. 3 shows a top, schematic view of the multichip package structure according to the third embodiment of the instant disclosure;

FIG. 4A shows a top, schematic view of the multichip package structure according to the fourth embodiment of the instant disclosure;

FIG. 4B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the fourth embodiment of the instant disclosure;

FIG. 5A shows a top, schematic view of the multichip package structure according to the fifth embodiment of the instant disclosure;

FIG. 5B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the fifth embodiment of the instant disclosure;

FIG. 6A shows a top, schematic view of the multichip package structure according to the sixth embodiment of the instant disclosure;

FIG. 6B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the sixth embodiment of the instant disclosure;

FIG. 7A shows a top, schematic view of the multichip package structure according to the seventh embodiment of the instant disclosure;

FIG. 7B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the seventh embodiment of the instant disclosure;

FIG. 8 shows a top, schematic view of the multichip package structure according to the eighth embodiment of the instant disclosure;

FIG. 9A shows a top, schematic view of the multichip package structure according to the ninth embodiment of the instant disclosure;

FIG. 9B shows a lateral, cross-sectional, schematic view of the multichip package structure according to the ninth embodiment of the instant disclosure;

FIG. 10 shows a lateral, cross-sectional, schematic view of the multichip package structure according to the tenth embodiment of the instant disclosure;

3

FIG. 11 shows a lateral, cross-sectional, schematic view of the multichip package structure according to the eleventh embodiment of the instant disclosure;

FIG. 12 shows a lateral, cross-sectional, schematic view of the multichip package structure according to the twelfth embodiment of the instant disclosure;

FIG. 13 shows a partial, top, schematic view of the substrate unit using standby pads;

FIG. 14A shows a function block diagram of the multichip package structure extra using a surge absorber, a fuse and a voltage-stabilizing unit according to any embodiment of the instant disclosure; and

FIG. 14B shows a circuit block diagram of the multichip package structure extra using a surge absorber, a fuse and a voltage-stabilizing unit according to any embodiment of the instant disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1A to 1D, the first embodiment of the instant disclosure provides a multichip package structure Z for directly electrically connecting to an AC power source S (such as commercial AC power socket provided with 110 v or 220 v etc.). The multichip package structure Z comprises a substrate unit 1, a light-emitting unit 2, a control module C, a frame unit 3 and a package unit 4.

The substrate unit 1 includes a substrate body 10 having a first chip-placing region 11 and a second chip-placing region 12 formed on the top surface of the substrate body 10. For example, the substrate body 10 includes a circuit substrate 100, a heat-dissipating layer 101 disposed on the bottom surface of the circuit substrate 100, a plurality of conductive pads 102 disposed on the top surface of the circuit substrate 100, and an insulative layer 103 disposed on the top surface of the circuit substrate 100 to expose the conductive pads 102. Hence, the heat-dissipating efficiency of the circuit substrate 100 is increased by using the heat-dissipating layer 101, and the insulative layer 103 is a solder mask for only exposing the conductive pads 102 in order to achieve local soldering. However, the above-mentioned definition of the substrate body 10 is not to limit the instant disclosure, for example, the substrate body 10 can be a PCB (Printed Circuit Board), a flexible substrate, an aluminum substrate, a ceramic substrate, or a copper substrate.

The light-emitting unit 2 includes a plurality of light-emitting chips (bare die state) 20 electrically connected to and disposed on the first chip-placing region 11. For example, each light-emitting chip 20 may be an LED (Light-emitting diode) such as a blue LED, and each light-emitting chip 20 can be electrically connected to the first chip-placing region 11 by wire bonding. In other words, designer can plan a predetermined first chip-placing region 11 on the substrate body 10 in advance, thus the first light-emitting chips 20 can be placed on the first chip-placing region 11.

The control module C includes at least one current-limiting unit (such as current-limiting chip) C1 and at least one rectifier unit (such as bridge rectifying chip or bridge rectifier) C2 electrically connected to and disposed on the second chip-placing region 12, and the current-limiting unit C1 and the rectifier unit C2 are electrically connected to the light-emitting unit 2. Of course, the control module C can also include a plurality of current-limiting units C1 on the second chip-placing region 12 for different requirements of amperage or current. For example, the current-limiting unit C1 and the rectifier unit C2 can be electrically connected to the second chip-placing region 12 by wire bonding and electrically con-

4

nected between the AC power source S and the light-emitting unit 2 (as shown in FIG. 1D). In other words, designer can plan a predetermined second chip-placing region 12 on the substrate body 10 in advance, thus the current-limiting unit C1 and the rectifier unit C2 can be placed on the second chip-placing region 12. In addition, the AC power source S can be transformed into a DC (direct current) power source through the rectifier unit C2, thus the light-emitting unit 2 can obtain constant voltage from the DC power source through the current-limiting unit C1.

The frame unit 3 includes a first annular colloid frame 30 and a second annular colloid frame 31 surroundingly formed on the top surface of the substrate body 10 by coating or other forming method. The first annular colloid frame 30 surrounds the light-emitting chips 20 to form a first colloid position limiting space 300 corresponding to the first chip-placing region 11, and the second annular colloid frame 31 surrounds the current-limiting unit C1 and the rectifier unit C2 to form a second colloid position limiting space 310 corresponding to the second chip-placing region 12. The first annular colloid frame 30 and the second annular colloid frame 31 are separated from each other by a predetermined distance.

For example, the method for forming the first annular colloid frame 30 (or the second annular colloid frame 31) includes: first, surroundingly coating liquid colloid (not shown) on the top surface of the substrate body 10. In addition, the liquid colloid can be coated on the substrate body 10 to form any shapes according to different requirements (such as a circular shape, a square or a rectangular shape etc.). The thixotropic index of the liquid colloid may be between 4 and 6, the pressure of coating the liquid colloid on the top surface of the substrate body 10 may be between 350 kpa and 450 kpa, and the velocity of coating the liquid colloid on the top surface of the substrate body 10 may be between 5 mm/s and 15 mm/s. The liquid colloid is surroundingly coated on the top surface of the substrate body 10 from a start point to a termination point, and the position of the start point and the position of the termination point are substantially the same, thus the first annular colloid frame 30 (or the second annular colloid frame 31) has a micro convex portion close to the start point and the termination point. Furthermore, the method further includes: hardening or curing the liquid colloid to form a first annular colloid frame 30. In addition, the liquid colloid is hardened by baking, the baking temperature may be between 120° C. and 140° C., and the baking time may be between 20 minute and 40 minute. Therefore, the first annular colloid frame 30 has an arc shape formed on the top surface thereof, the first annular colloid frame 30 has a radius tangent T and the angle θ of the radius tangent T relative to the top surface of the substrate body 10 may be between 40° C. and 50° C., the maximum height H of the first annular colloid frame 30 relative to the top surface of the substrate body 10 may be between 0.3 mm and 0.7 mm, the width D of the bottom side of the first annular colloid frame 30 may be between 1.5 mm and 3 mm, the thixotropic index of the first annular colloid frame 30 may be between 4 and 6, and the first annular colloid frame 30 is formed by mixing inorganic additive with white thermohardening colloid.

The package unit 4 includes a first package colloid body 40 filled into the first colloid position limiting space 300 to cover the light-emitting chips 20 and a second package colloid body 41 filled into the second colloid position limiting space 310 to cover the current-limiting unit C1 and the rectifier unit C2. The first package colloid body 40 and the second package colloid body 41 are separated from each other by a predetermined distance, and the first annular colloid frame 30 and the second package colloid body 41 are separated from each

5

other by a predetermined distance. For example, the first package colloid body **40** may be a light-permitting colloid body such as cured phosphor colloid or cured transparent colloid, thus blue light beams **L1** generated by the light-emitting chips **20** (the blue LED chips) can pass through the first package colloid body **40** (the cured phosphor colloid) to generate white light beams **L2** that are similar to the light source generate by sun lamp. In addition, the second package colloid body **41** may be a cured opaque colloid covering the current-limiting unit **C1** and the rectifier unit **C2**, thus the second package colloid body **41** can prevent the current-limiting unit **C1** and the rectifier unit **C2** from being damaged or affected by lighting of the white light beams **L2**.

The substrate unit **1** further includes at least one heat-insulating slot **13** passing through the substrate body **10**, and the heat-insulating slot **13** is formed between the light-emitting unit **2** and the control module **C** or between the first annular colloid frame **30** and the second annular colloid frame **31**. Hence, the heat-transmitting path between the light-emitting unit **2** and the control module **C** can be effectively reduced by using the heat-insulating slot **13**, thus the velocity of transmitting the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** to the light-emitting unit **2** can be effectively decreased.

Referring to FIGS. **2A** and **2B**, the second embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **2A** with FIG. **1A** (or FIG. **2B** with FIG. **1B**), the difference between the second embodiment and the first embodiment is that: the heat-insulating slot **13** shown in FIG. **2A** can be omitted in the second embodiment. For example, when the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** is very small, the user can use the second embodiment.

Referring to FIG. **3**, the third embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **3** with FIG. **1C**, the difference between the third embodiment and the first embodiment is that: the control module **C** is disposed between the first annular colloid frame **30** and the second annular colloid frame **31**, the second annular colloid frame **31** surrounds the first annular colloid frame **30**, the second package colloid body **41** surrounds the first package colloid body **40**, and the first annular colloid frame **30** is connected with the second package colloid body **41**. In other words, the first annular colloid frame **30** only surrounds the light-emitting chips **20**, the second annular colloid frame **31** simultaneously surrounds the light-emitting chips **20**, the first annular colloid frame **30**, the current-limiting unit **C1** and the rectifier unit **C2**, thus the first annular colloid frame **30** and the second annular colloid frame **31** are arranged to form a concentric circle.

The substrate unit **1** further includes at least one heat-insulating slot **13** passing through the substrate body **10**, and the heat-insulating slot **13** is formed between the light-emitting unit **2** and the control module **C** or between the first annular colloid frame **30** and the second annular colloid frame **31**. Hence, the heat-transmitting path between the light-emitting unit **2** and the control module **C** can be effectively reduced by using the heat-insulating slot **13**, thus the velocity of transmitting the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** to the light-emitting unit **2** can be effectively decreased. Of course, when the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** is very small, the heat-insulating slot **13** shown in FIG. **3** can be omitted.

6

Referring to FIGS. **4A** and **4B**, the fourth embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). The multichip package structure **Z** comprises a substrate unit **1**, a light-emitting unit **2**, a control module **C**, a frame unit **3** and a package unit **4**.

The substrate unit **1** includes a substrate body **10** having two first chip-placing regions **11** and a second chip-placing region **12** formed on the top surface of the substrate body **10**. For example, the substrate body **10** includes a circuit substrate **100**, a heat-dissipating layer **101** disposed on the bottom surface of the circuit substrate **100**, a plurality conductive pads **102** disposed on the top surface of the circuit substrate **100**, and an insulative layer **103** disposed on the top surface of the circuit substrate **100** to expose the conductive pads **102**.

The light-emitting unit **2** includes at least one first light-emitting module **2a** for generating first color temperature and at least one second light-emitting module **2b** for generating second color temperature. The first light-emitting module **2a** includes a plurality of first light-emitting chips **20a** electrically connected to and disposed on one of the first chip-placing regions **11**, and the second light-emitting module **2b** includes a plurality of second light-emitting chips **20b** electrically connected to and disposed on the other first chip-placing region **11**. For example, each first light-emitting chip **20a** and each second light-emitting chip **20b** may be a blue LED, and each first light-emitting chip **20a** and each second light-emitting chip **20b** can be respectively and electrically connected to the two first chip-placing regions **11** by wire bonding.

The control module **C** includes at least one current-limiting unit **C1** and at least one rectifier unit **C2** electrically connected to and disposed on the second chip-placing region **12**, and the current-limiting unit **C1** and the rectifier unit **C2** are electrically connected to the light-emitting unit **2**. Of course, the control module **C** can also include a plurality of current-limiting units **C1** on the second chip-placing region **12** for different requirements of amperage or current. For example, the current-limiting unit **C1** and the rectifier unit **C2** can be electrically connected to the second chip-placing region **12** by wire bonding and electrically connected between the AC power source (not shown) and the light-emitting unit **2**. In addition, the AC power source (not shown) can be transformed into a DC power source through the rectifier unit **C2**, thus the light-emitting unit **2** can obtain constant voltage from the DC power source through the current-limiting unit **C1**.

The frame unit **3** includes two first annular colloid frames **30** and a second annular colloid frame **31** surroundingly formed on the top surface of the substrate body **10** by coating or other forming method. The two first annular colloid frames **30** respectively surround the first light-emitting module **2a** and the second light-emitting module **2b** to respectively form two first colloid position limiting spaces **300** corresponding to the two first chip-placing regions **11**, and the second annular colloid frame **31** surrounds the current-limiting unit **C1** and the rectifier unit **C2** to form a second colloid position limiting space **310** corresponding to the second chip-placing region **12**. The two first annular colloid frames **30** are separated from each other and arranged on the substrate body **10** in parallel, and each first annular colloid frame **30** and the second annular colloid frame **31** are separated from each other.

The package unit **4** includes two first package colloid bodies (**40a**, **40b**) and a second package colloid body **41**. The two first package colloid bodies (**40a**, **40b**) are respectively filled into the two first colloid position limiting spaces **300** to respectively cover the first light-emitting module **2a** and the

7

second light-emitting module **2b**, and the second package colloid body **41** is filled into the second colloid position limiting space **310** to cover the current-limiting unit **C1** and the rectifier unit **C2**. Each first package colloid bodies (**40a**, **40b**) and the second package colloid body **41** are separated from each other, and each first annular colloid frame **30** and the second package colloid body **41** are separated from each other. For example, one first package colloid body **40a** may be a cured phosphor colloid with first color, the other first package colloid body **40b** may be a cured phosphor colloid with second color, and the second package colloid body **41** may be a cured opaque colloid.

The substrate unit **1** further includes at least one heat-insulating slot **13** passing through the substrate body **10**, and the heat-insulating slot **13** is formed between the light-emitting unit **2** and the control module **C** or between one of the two first annular colloid frames **30** and the second annular colloid frame **31**, thus the velocity of transmitting the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** to the light-emitting unit **2** can be effectively decreased. Of course, when the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** is very small, the heat-insulating slot **13** can be omitted.

The first light-emitting structure **N1** may comprises the substrate body **10**, the first light-emitting chips **20a**, one first annular colloid frame **30** and one first package colloid body **40a**. The second light-emitting structure **N2** may comprises the substrate body **10**, the second light-emitting chips **20b**, the other first annular colloid frame **30** and the other first package colloid body **40b**.

Referring to FIGS. **5A** and **5B**, the fifth embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **5A** with FIG. **4A** (or FIG. **5B** with FIG. **4B**), the difference between the fifth embodiment and the fourth embodiment is that: in the fifth embodiment, the two first annular colloid frames **30** can be arranged on the substrate body **10** in series.

Referring to FIGS. **6A** and **6B**, the sixth embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **6A** with FIG. **5A** (or FIG. **6B** with FIG. **5B**), the difference between the sixth embodiment and the fifth embodiment is that: in the sixth embodiment, each first annular colloid frame **30** may be a cured phosphor colloid. In other words, phosphor powders can be selectively add to each first annular colloid frame **30** according to different requirements, thus dark bands generated between the two first package colloid bodies (**40a**, **40b**) can be effectively decreased or eliminated.

Referring to FIGS. **7A** and **7B**, the seventh embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). The multichip package structure **Z** comprises a substrate unit **1**, a light-emitting unit **2**, a control module **C**, a frame unit **3** and a package unit **4**.

The substrate unit **1** includes a substrate body **10** having two first chip-placing regions **11** and a second chip-placing region **12** formed on the top surface of the substrate body **10**. The light-emitting unit **2** includes at least one first light-emitting module **2a** for generating first color temperature and at least one second light-emitting module **2b** for generating second color temperature. The first light-emitting module **2a** includes a plurality of first light-emitting chips **20a** electrically connected to and disposed on one of the first chip-placing regions **11**, and the second light-emitting module **2b** includes a plurality of second light-emitting chips **20b** elec-

8

trically connected to and disposed on the other first chip-placing region **11**. The control module **C** includes at least one current-limiting unit **C1** and at least one rectifier unit **C2** electrically connected to and disposed on the second chip-placing region **12**, and the current-limiting unit **C1** and the rectifier unit **C2** are electrically connected to the light-emitting unit **2**.

The frame unit **3** includes two first annular colloid frames (**30a**, **30b**) and a second annular colloid frame **31** surrounding formed on the top surface of the substrate body **10** by coating or other forming method. One first annular colloid frame **30b** surrounds the other first annular colloid frame **30a**, thus the two first annular colloid frames (**30a**, **30b**) are arranged to form a concentric circle. The two first annular colloid frames (**30a**, **30b**) respectively surround the first light-emitting module **2a** and the second light-emitting module **2b** to respectively form two first colloid position limiting spaces **300** corresponding to the two first chip-placing regions **11**, the second light-emitting module **2b** is disposed between the two first annular colloid frames (**30a**, **30b**), and the second annular colloid frame **31** surrounds the current-limiting unit **C1** and the rectifier unit **C2** to form a second colloid position limiting space **310** corresponding to the second chip-placing region **12**. The package unit **4** includes two first package colloid bodies (**40a**, **40b**) and a second package colloid body **41**. The two first package colloid bodies (**40a**, **40b**) are respectively filled into the two first colloid position limiting spaces **300** to respectively cover the first light-emitting module **2a** and the second light-emitting module **2b**, and the second package colloid body **41** is filled into the second colloid position limiting space **310** to cover the current-limiting unit **C1** and the rectifier unit **C2**.

The substrate unit **1** further includes at least one heat-insulating slot **13** passing through the substrate body **10**, and the heat-insulating slot **13** is formed between the light-emitting unit **2** and the control module **C** or between one of the two first annular colloid frames **30b** and the second annular colloid frame **31**, thus the velocity of transmitting the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** to the light-emitting unit **2** can be effectively decreased. Of course, when the heat generated by the current-limiting unit **C1** and the rectifier unit **C2** is very small, the heat-insulating slot **13** can be omitted.

The first light-emitting structure **N1** may comprises the substrate body **10**, the first light-emitting chips **20a**, one first annular colloid frame **30a** and one first package colloid body **40a**. The second light-emitting structure **N2** may comprises the substrate body **10**, the second light-emitting chips **20b**, the other first annular colloid frame **30b** and the other first package colloid body **40b**. In addition, the second light-emitting structure **N2** with high color temperature can be an outer ring to surround the first light-emitting structure **N1** with low color temperature.

Referring to FIG. **8**, the eighth embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **8** with FIG. **7A**, the difference between the eighth embodiment and the seventh embodiment is that: in the eighth embodiment, the first light-emitting structure **N1** with low color temperature can be an outer ring to surround the second light-emitting structure **N2** with high color temperature.

Referring to FIGS. **9A** and **9B**, the ninth embodiment of the instant disclosure provides a multichip package structure **Z** for directly electrically connecting to an AC power source (not shown). Comparing FIG. **9A** with FIG. **7A** (or FIG. **9B** with FIG. **7B**), the difference between the ninth embodiment

and the seventh embodiment is that: in the ninth embodiment, each first annular colloid frame (30a, 30b) may be a cured phosphor colloid. In other words, phosphor powders can be selectively add to each first annular colloid frame (30a, 30b) according to different requirements, thus dark bands generated between the two first package colloid bodies (40a, 40b) can be effectively decreased or eliminated.

Referring to FIG. 10, the tenth embodiment of the instant disclosure provides a multichip package structure Z for directly electrically connecting to an AC power source (not shown). Comparing FIG. 10 with FIG. 7B, the difference between the tenth embodiment and the seventh embodiment is that: in the tenth embodiment, the inner first annular colloid frame 30a may be a cured phosphor colloid and the outer first annular colloid frame 30b may be a cured light-reflecting colloid. In other words, phosphor powders can be selectively add to the inner first annular colloid frame 30a according to different requirements, thus light beams generated by the light-emitting unit 2 can be transmitted into the inner first annular colloid frame 30a for effectively decreasing or eliminating dark bands generated between the two first package colloid bodies (40a, 40b). In addition, light beams generated by the light-emitting unit 2 can be effectively reflected or condensed by the outer first annular colloid frame 30b.

Referring to FIG. 11, the eleventh embodiment of the instant disclosure provides a multichip package structure Z for directly electrically connecting to an AC power source (not shown). The multichip package structure Z comprises a substrate unit 1, a light-emitting unit 2, a control module C and a package unit 4. The substrate unit 1 includes a substrate body 10 having a chip-placing region 11 formed on the top surface of the substrate body 10. The light-emitting unit 2 includes a plurality of light-emitting chips (bare die state) 20 electrically connected to and disposed on the chip-placing region 11. The control module C includes an annular substrate C' electrically connected to and disposed on the substrate body 10, at least one current-limiting unit C1 and at least one rectifier unit C2 electrically connected to and disposed on the annular substrate C', and an opaque package colloid body C'' covering the current-limiting unit C1 and the rectifier unit C2. The current-limiting unit C1 and the rectifier unit C2 are electrically connected to the light-emitting unit 2. The annular substrate C' surrounds the light-emitting chips 20 to form a position limiting space 300. The package unit 4 includes a light-permitting package colloid body 40 filled into the position limiting space 300 to cover the light-emitting chips 20.

Referring to FIG. 12, the twelfth embodiment of the instant disclosure provides a multichip package structure Z for directly electrically connecting to an AC power source (not shown). The multichip package structure Z comprises a substrate unit 1, a light-emitting unit 2, a control module C, a frame unit 3 and a package unit 4. The substrate unit 1 includes a substrate body 10 having a chip-placing region 11 formed on the top surface of the substrate body 10. The light-emitting unit 2 includes a plurality of light-emitting chips (bare die state) 20 electrically connected to and disposed on the chip-placing region 11. The frame unit 3 includes an annular colloid frame 30 surrounding formed on the top surface of the substrate body 10 by coating or other forming method, and the annular colloid frame 30 surrounds the light-emitting chips 20 to form a position limiting space 300 corresponding to the chip-placing region 11. The package unit 4 includes a light-permitting package colloid body 40 filled into the position limiting space 300 to cover the light-emitting chips 20. The control module C includes an annular substrate C' electrically connected to and disposed on the

substrate body 10, at least one current-limiting unit C1 and at least one rectifier unit C2 electrically connected to and disposed on the annular substrate C', and an opaque package colloid body C'' covering the current-limiting unit C1 and the rectifier unit C2. The current-limiting unit C1 and the rectifier unit C2 are electrically connected to the light-emitting unit 2.

Referring to FIG. 13, in the first to the twelfth embodiments, the substrate unit 1 includes a plurality of positive pads P and negative pads N disposed on the top surface of the substrate body 10. Each light-emitting chip (20 or 20a, 20b) has a positive electrode 201 and a negative electrode 202. The positive electrode 201 of each light-emitting chip 20 corresponds to at least two of the positive pads P, and the negative electrode 202 of each light-emitting chip 20 corresponds to at least two of the negative pads N. In addition, the multichip package structure further comprises a conductive wire unit W including a plurality of conductive wires W1. Every two conductive wires W1 are respectively electrically connected between the positive electrode 201 of each light-emitting chip 20 and one of the at least two positive pads P and between the negative electrode 202 of each light-emitting chip 20 and one of the at least two negative pads N. Hence, the positive electrode 201 of each light-emitting chip 20 has at least one standby positive pad P and the negative electrode 202 of each light-emitting chip 20 has at least one standby negative pad N.

When a first end of the conductive wire W1 does not correctly connect with first one of the at least two positive pads P or the at least two negative pads N (it means that the conductive wire W1 does not electrically connect with the first one of the at least two positive pads P or the at least two negative pads N (such as floating solder)), the manufacturer can make the same first end of the conductive wire W1 connect to another one of the at least two positive pads P or the at least two negative pads N without cleaning solder splash on the surface of the first one of the at least two positive pads P or the at least two negative pads N, thus the wire-bonding time (the wire-bonding efficiency) can be decreased and the wire-bonding yield can be increased.

Referring to FIGS. 14A and 14B, in the first to the twelfth embodiments, the control module C can further include at least one surge absorber C5, at least one fuse C4 and at least one voltage-stabilizing unit C3 (such as plastic capacitor) electrically connected to and disposed on the second chip-placing region 12. The surge absorber C5, the fuse C4, the voltage-stabilizing unit C3, the rectifier unit C2 (such as a bridge rectifying chip) and the current-limiting unit C1 (such as a current-limiting chip) are sequentially arranged on the second chip-placing region 12 and electrically connected between the AC power source S and the light-emitting unit 2. In other words, the surge absorber C5, the fuse C4, the voltage-stabilizing unit C3, the rectifier unit C2 and the current-limiting unit C1 can be disposed on the second chip-placing region 12 at the same time, thus AC currents generated from the AC power source S can sequentially pass through the fuse C4, the surge absorber C3, the rectifier unit C2 and the current-limiting unit C1 to form constant DC currents for the light-emitting unit 2.

In conclusion, the first annular colloid frame (such as an annular white colloid frame) of any shapes can be formed by coating in the instant disclosure. In addition, the position of the first package colloid body such as cured phosphor colloid can be limited in the first colloid position limiting space by using the first annular colloid frame, and the shape of the first package colloid body can be adjusted by using the first annular colloid frame. Therefore, the instant disclosure can increase the light-emitting efficiency of the light-emitting chips and control the light-projecting angle of the light-emitting

11

ting chips. In other words, the first package colloid body is limited in the first colloid position limiting space by using the first annular colloid frame, thus the usage quantity of the first package colloid body can be controlled by the manufacture. In addition, the surface shape and the height of the first package colloid body can be adjusted by controlling the usage quantity of the first package colloid body, thus the light-projecting angles of the white light beams can be adjusted. Moreover, the blue light beams generated by the light-emitting chips can be reflected by an inner wall of the first annular colloid frame, thus the light-emitting efficiency of the instant disclosure can be effectively increased.

Moreover, the positive electrode and the negative electrode of each light-emitting chip respectively correspond to at least two of the positive pads and at least two of the negative pads, thus the positive electrode of each light-emitting chip has at least one standby positive pad and the negative electrode of each light-emitting chip has at least one standby negative pad.

Furthermore, the light-emitting chips, the at least one current-limiting unit and the at least one rectifier unit are electrically connected to the same substrate body, thus the multichip package structure can directly electrically connect to an AC power source (such as commercial AC power socket) as power supply source.

The above-mentioned descriptions merely represent the preferred embodiments of the instant disclosure, without any intention or ability to limit the scope of the instant disclosure which is fully described only within the following claims. Various equivalent changes, alterations or modifications based on the claims of instant disclosure are all, consequently, viewed as being embraced by the scope of the instant disclosure.

What is claimed is:

1. A multichip package structure for directly electrically connecting to an AC power source, comprising:

- a substrate unit including a substrate body having a first chip-placing region and a second chip-placing region formed on the top surface of the substrate body;
- a light-emitting unit including a plurality of light-emitting chips electrically connected to and disposed on the first chip-placing region;
- a control module including at least one current-limiting unit and at least one rectifier unit electrically connected to and disposed on the second chip-placing region, wherein the current-limiting unit and the rectifier unit are electrically connected to the light-emitting unit;
- a frame unit including a first annular colloid frame and a second annular colloid frame, wherein the first annular colloid frame surrounds the light-emitting chips to form a first colloid position limiting space corresponding to the first chip-placing region, and the second annular colloid frame surrounds the current-limiting unit and the rectifier unit to form a second colloid position limiting space corresponding to the second chip-placing region; and
- a package unit including a first package colloid body filled into the first colloid position limiting space to cover the light-emitting chips and a second package colloid body filled into the second colloid position limiting space to cover the current-limiting unit and the rectifier unit;

wherein the first annular colloid frame is surroundingly coated on the top surface of the substrate body from a first initial point to a first terminal point, the position of the first initial point and the position of the first terminal point are substantially the same, such that the first annular colloid frame has a first micro convex portion adjacent to the first initial point and the first terminal point;

12

wherein the second annular colloid frame is surroundingly coated on the top surface of the substrate body from a second initial point to a second terminal point, the position of the second initial point and the position of the second terminal point are substantially the same, such that the second annular colloid frame has a second micro convex portion adjacent to the second initial point and the second terminal point.

2. The multichip package structure of claim 1, wherein the control module further includes at least one surge absorber, at least one fuse and at least one voltage-stabilizing unit electrically connected to and disposed on the second chip-placing region, and the surge absorber, the fuse, the voltage-stabilizing unit, the rectifier unit and the current-limiting unit are sequentially arranged on the second chip-placing region and electrically connected between the AC power source and the light-emitting unit, wherein the current-limiting unit is a current-limiting chip and the rectifier unit is a bridge rectifying chip.

3. The multichip package structure of claim 1, wherein the first annular colloid frame has an arc shape formed on the top surface thereof, the first annular colloid frame has a radius tangent and the angle of the radius tangent relative to the top surface of the substrate body is between 40° and 50°, the maximum height of the first annular colloid frame relative to the top surface of the substrate body is between 0.3 mm and 0.7 mm, the width of the bottom side of the first annular colloid frame is between 1.5 mm and 3 mm, the thixotropic index of the first annular colloid frame is between 4 and 6, and the first annular colloid frame is formed by mixing inorganic additive with white thermohardening colloid.

4. The multichip package structure of claim 1, wherein the substrate unit includes a plurality of positive pads and negative pads disposed on the top surface of the substrate body, each light-emitting chip has a positive electrode and a negative electrode, the positive electrode of each light-emitting chip corresponds to at least two of the positive pads, and the negative electrode of each light-emitting chip corresponds to at least two of the negative pads.

5. The multichip package structure of claim 4, further comprising: a conductive wire unit including a plurality of conductive wires, wherein every two conductive wires are respectively electrically connected between the positive electrode of each light-emitting chip and one of the at least two positive pads and between the negative electrode of each light-emitting chip and one of the at least two negative pads.

6. The multichip package structure of claim 1, wherein the first annular colloid frame and the second annular colloid frame are separated from each other by a predetermined distance, the first package colloid body and the second package colloid body are separated from each other by a predetermined distance, and the first annular colloid frame and the second package colloid body are separated from each other by a predetermined distance.

7. The multichip package structure of claim 1, wherein the second annular colloid frame surrounds the first annular colloid frame, the second package colloid body surrounds the first package colloid body, and the first annular colloid frame is connected with the second package colloid body.

8. The multichip package structure of claim 1, wherein the substrate unit includes at least one heat-insulating slot passing through the substrate body, and the heat-insulating slot is formed between the light-emitting unit and the control module or between the first annular colloid frame and the second annular colloid frame.

9. A multichip package structure for directly electrically connecting to an AC power source, comprising:

13

a substrate unit including a substrate body having two first chip-placing regions and a second chip-placing region formed on the top surface of the substrate body;

a light-emitting unit including at least one first light-emitting module for generating first color temperature and at least one second light-emitting module for generating second color temperature, wherein the first light-emitting module includes a plurality of first light-emitting chips electrically connected to and disposed on one of the first chip-placing regions, and the second light-emitting module includes a plurality of second light-emitting chips electrically connected to and disposed on the other first chip-placing region;

a control module including at least one current-limiting unit and at least one rectifier unit electrically connected to and disposed on the second chip-placing region, wherein the current-limiting unit and the rectifier unit are electrically connected to the light-emitting unit;

a frame unit including two first annular colloid frames and a second annular colloid frame, wherein the two first annular colloid frames respectively surround the first light-emitting module and the second light-emitting module to respectively form two first colloid position limiting spaces corresponding to the two first chip-placing regions, and the second annular colloid frame surrounds the current-limiting unit and the rectifier unit to form a second colloid position limiting space corresponding to the second chip-placing region; and

a package unit including two first package colloid bodies and a second package colloid body, wherein the two first package colloid bodies are respectively filled into the two first colloid position limiting spaces to respectively cover the first light-emitting module and the second light-emitting module, and the second package colloid body is filled into the second colloid position limiting space to cover the current-limiting unit and the rectifier unit;

wherein the first annular colloid frame is surroundingly coated on the top surface of the substrate body from a first initial point to a first terminal point, the position of the first initial point and the position of the first terminal point are substantially the same, such that the first annular colloid frame has a first micro convex portion adjacent to the first initial point and the first terminal point;

wherein the second annular colloid frame is surroundingly coated on the top surface of the substrate body from a second initial point to a second terminal point, the position of the second initial point and the position of the second terminal point are substantially the same, such that the second annular colloid frame has a second micro convex portion adjacent to the second initial point and the second terminal point.

10. A multichip package structure for directly electrically connecting to an AC power source, comprising:

a substrate unit including a substrate body having two first chip-placing regions and a second chip-placing region formed on the top surface of the substrate body;

a light-emitting unit including at least one first light-emitting module for generating first color temperature and at least one second light-emitting module for generating second color temperature, wherein the first light-emitting module includes a plurality of first light-emitting chips electrically connected to and disposed on one of the first chip-placing regions, and the second light-emitting module includes a plurality of second light-emitting chips electrically connected to and disposed on the other first chip-placing region;

14

a control module including at least one current-limiting unit and at least one rectifier unit electrically connected to and disposed on the second chip-placing region, wherein the current-limiting unit and the rectifier unit are electrically connected to the light-emitting unit;

a frame unit including two first annular colloid frames and a second annular colloid frame, wherein one of the first annular colloid frames surrounds the other first annular colloid frame, the two first annular colloid frames respectively surround the first light-emitting module and the second light-emitting module to respectively form two first colloid position limiting spaces corresponding to the two first chip-placing regions, the second light-emitting module is disposed between the two first annular colloid frames, and the second annular colloid frame surrounds the current-limiting unit and the rectifier unit to form a second colloid position limiting space corresponding to the second chip-placing region; and

a package unit including two first package colloid bodies and a second package colloid body, wherein the two first package colloid bodies are respectively filled into the two first colloid position limiting spaces to respectively cover the first light-emitting module and the second light-emitting module, and the second package colloid body is filled into the second colloid position limiting space to cover the current-limiting unit and the rectifier unit;

wherein each first annular colloid frame is surroundingly coated on the top surface of the substrate body from a first initial point to a first terminal point, the position of the first initial point and the position of the first terminal point are substantially the same, such that the first annular colloid frame has a first micro convex portion adjacent to the first initial point and the first terminal point;

wherein the second annular colloid frame is surroundingly coated on the top surface of the substrate body from a second initial point to a second terminal point, the position of the second initial point and the position of the second terminal point are substantially the same, such that the second annular colloid frame has a second micro convex portion adjacent to the second initial point and the second terminal point.

11. The multichip package structure of claim 10, wherein the second package colloid body is a cured opaque colloid covering the at least one current-limiting unit and the at least one rectifier unit, for preventing the at least one current-limiting unit and the at least one rectifier unit from being damaged or affected by lighting of the light-emitting unit.

12. The multichip package structure of claim 10, wherein the substrate unit includes a plurality of first positive pads and a plurality of first negative pads disposed on the top surface of the substrate body, each first light-emitting chip has a first positive electrode and a first negative electrode, the first positive electrode of each first light-emitting chip corresponds to at least two of the first positive pads, the first negative electrode of each first light-emitting chip corresponds to at least two of the first negative pads, a first positive conductive wire is electrically connected between the first positive electrode of the first light-emitting chip and one of the at least two first positive pads, and a first negative conductive wire is electrically connected between the first negative electrode of the first light-emitting chip and one of the at least two first negative pads, thus another one of the at least two first positive pads is a first standby positive pad and another one of the at least two first negative pads is a first standby negative pad.

13. The multichip package structure of claim 10, wherein the substrate unit includes a plurality of second positive pads

and a plurality of second negative pads disposed on the top surface of the substrate body, each second light-emitting chip has a second positive electrode and a second negative electrode, the second positive electrode of each second light-emitting chip corresponds to at least two of the second positive pads, the second negative electrode of each second light-emitting chip corresponds to at least two of the second negative pads, a second positive conductive wire is electrically connected between the second positive electrode of the second light-emitting chip and one of the at least two second positive pads, and a second negative conductive wire is electrically connected between the second negative electrode of the second light-emitting chip and one of the at least two second negative pads, thus another one of the at least two second positive pads is a second standby positive pad and another one of the at least two second negative pads is a second standby negative pad.

* * * * *